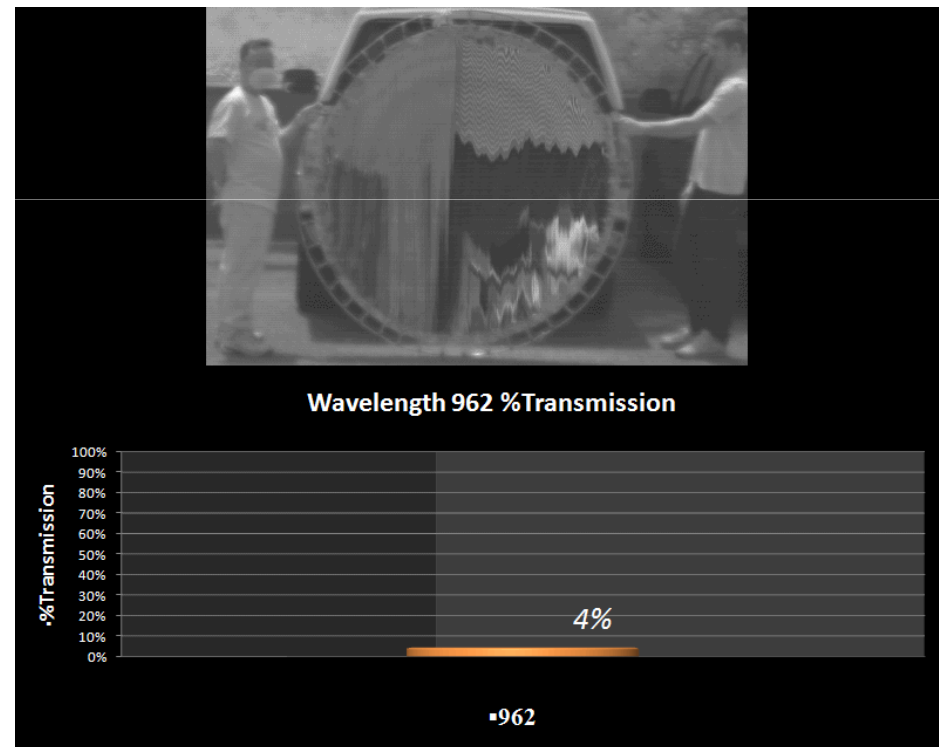


Very Large Solar Rejection Filter For Laser Communication

Surface Optics
Corporation

Dr. William Roberts-
COTR (JPL)

David A. Sheikh – PI

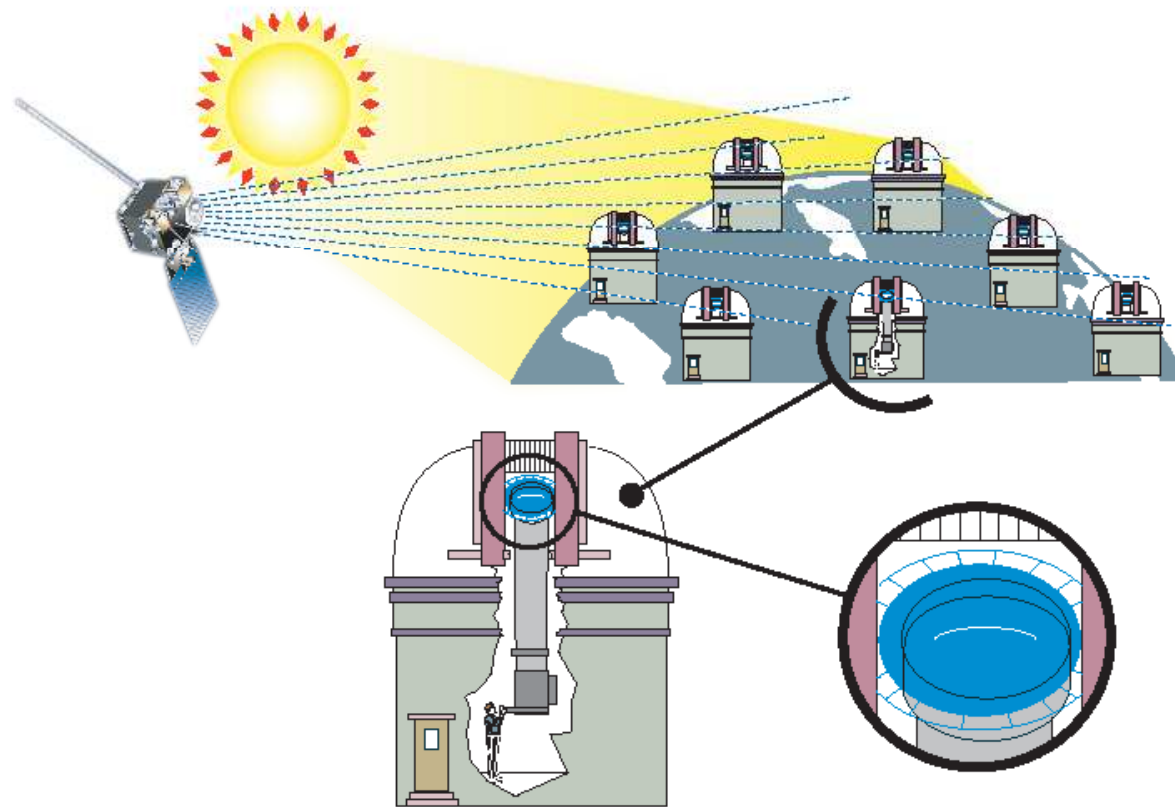


1.5-m Membrane Filter



Daylight, interplanetary laser communication

-





SURFACE OPTICS CORPORATION

[Coatings](#) [Hyperspectral](#) [Reflectometers](#) [Measurements](#) [Simulation](#) [Contact](#)

HYPERSPPECTRAL



HOME



SOC 700 MW

SOC 700 HZ

SOC 700 SW

MIDIS HYPERSENSOR

DUOCHROME-ML

DUOCHROME-SW

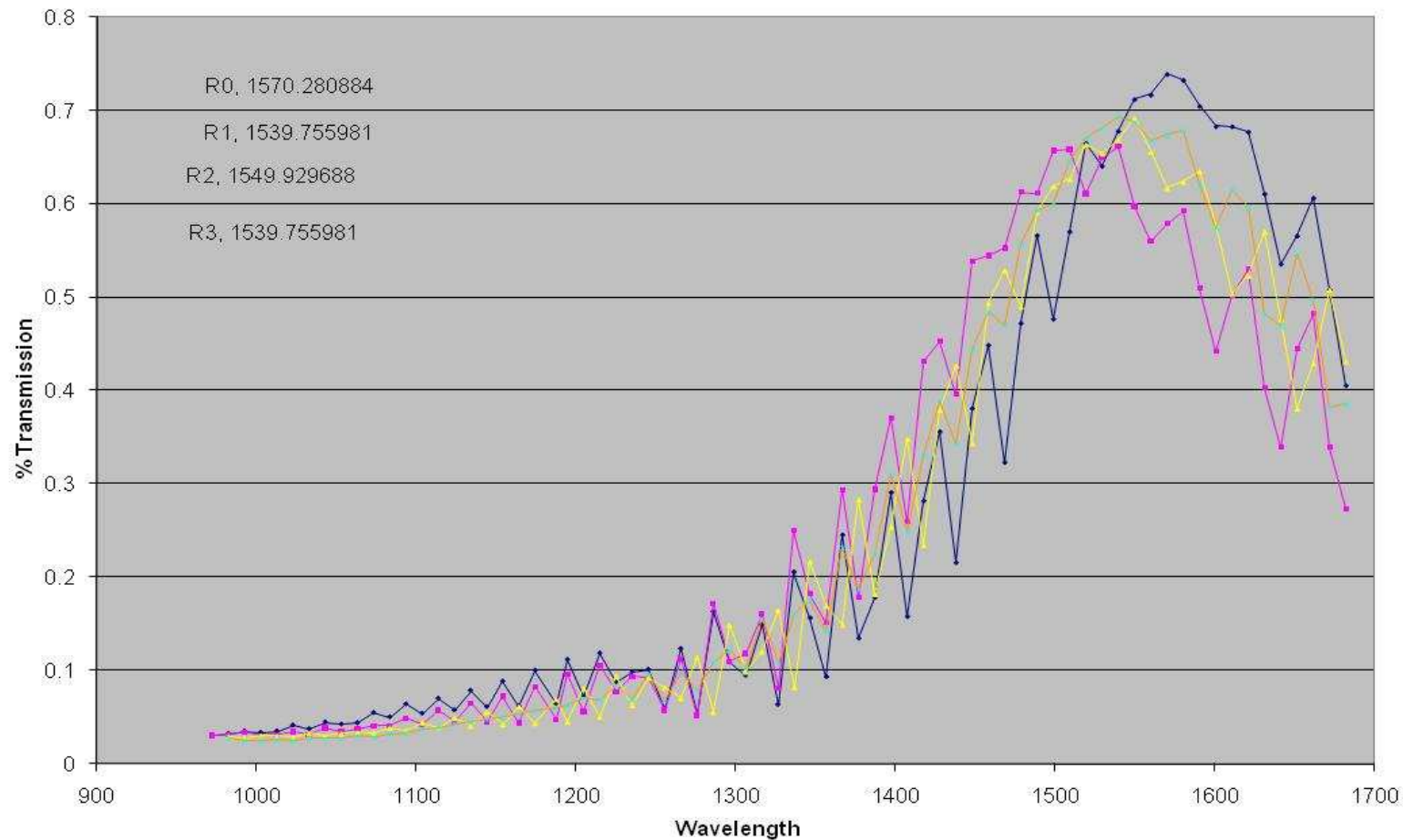


SPECIFICATIONS

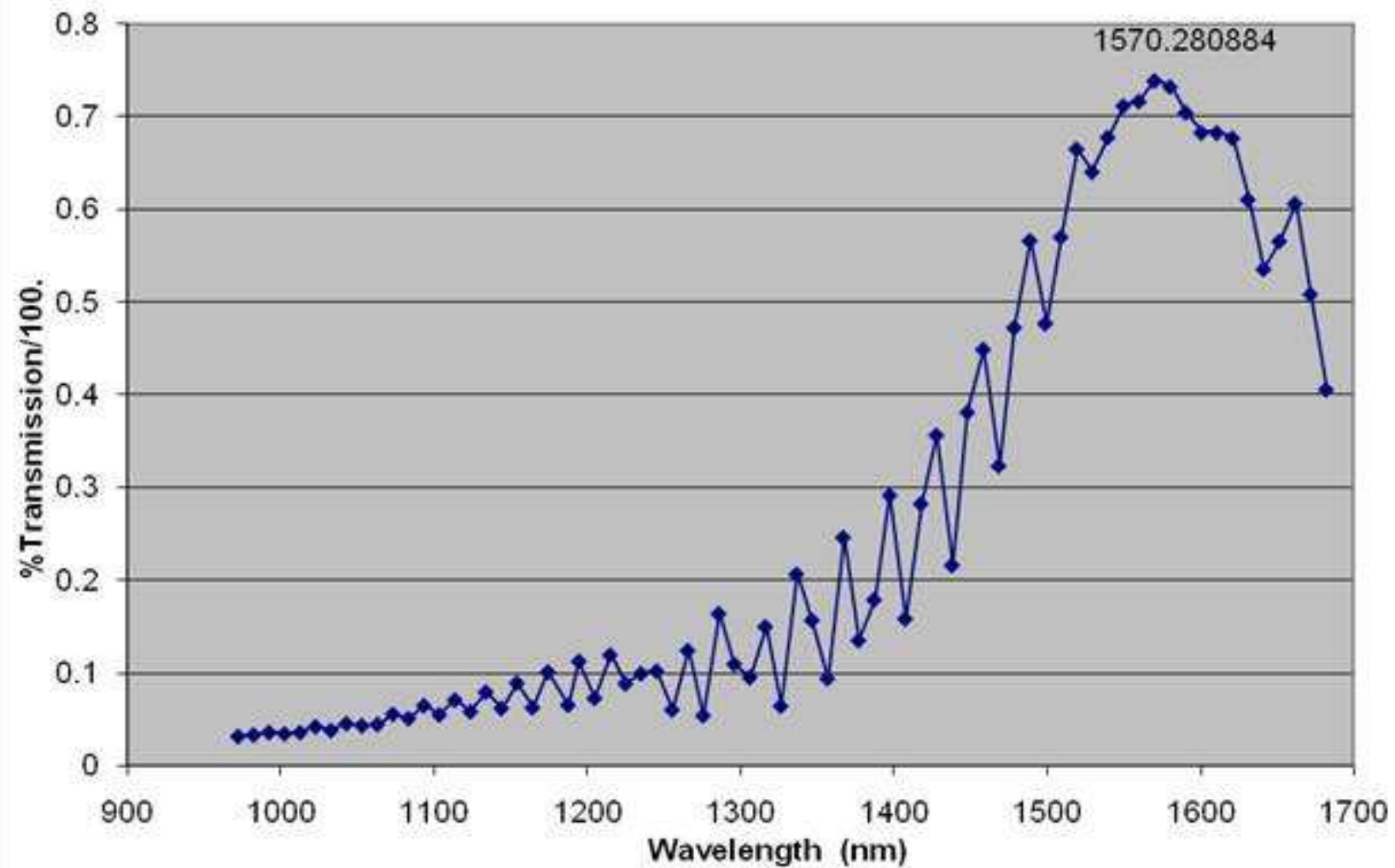
WAVELENGTH RANGE	1000-1700 NM
SPEED LINES/FRAMES PER SECOND	50/(0.1)
FRAMESIZE (PIXELS)	512 X 512
SPECTRAL RESOLUTION	6.5 NM
BANDS	128
COMPUTER INTERFACE	CAMERA LINK
POWER SUPPLY	AC
SOFTWARE	HS ANALYSIS 3
CALIBRATION	YES
RADIANCE (LENSES)	35 MM
TFOV/IFOV (DEGREES)	10/0.01953

Hyperspectral transmission data collected over 1.5-m area

% Transmission Comparison



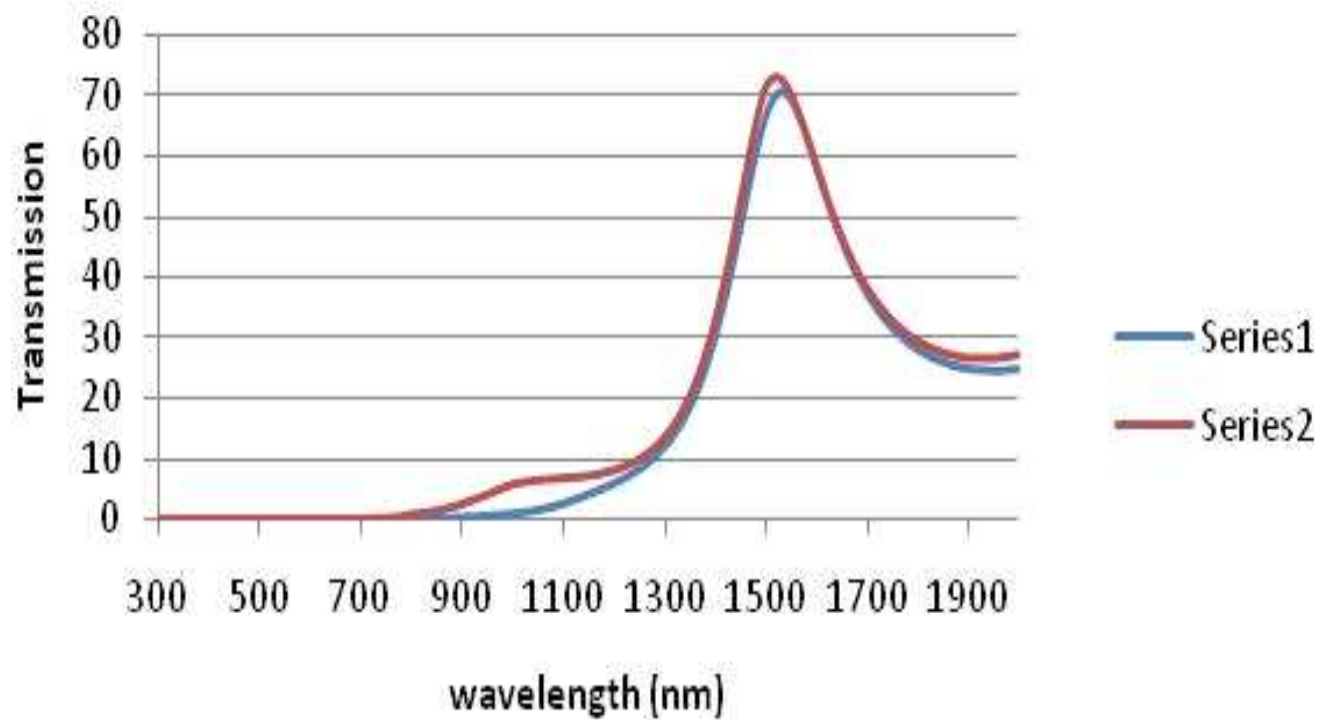
Hyperspectral Transmission Measurement Through Membrane



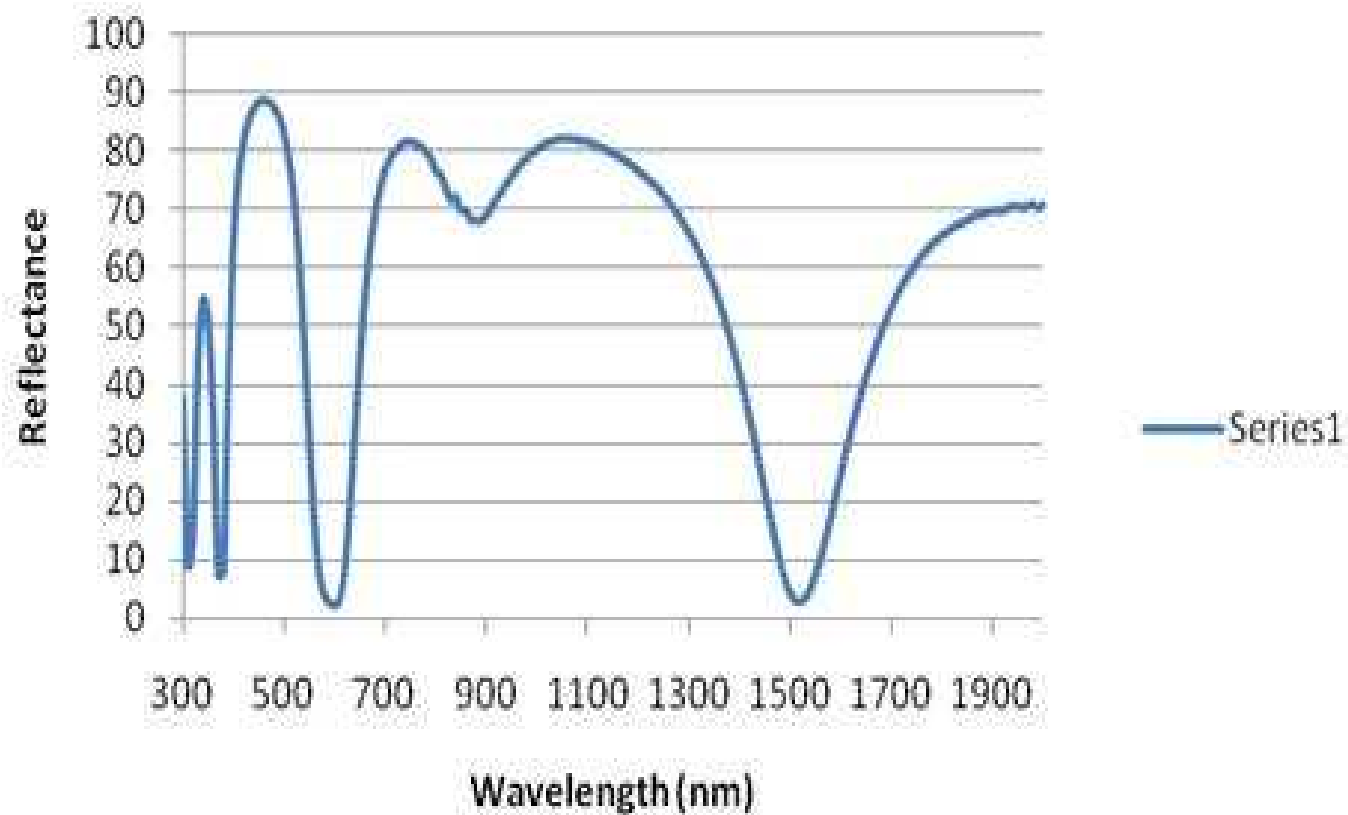
Filter Requirements

PARAMETER	SPECIFICATION
Transmission	90% external transmission from 1540-1560-nm
Incident Angle	0.0 +/- 2.0°
Blocking	Block transmission of the complete incident solar power spectrum to a level of: 97% over angles from 0-30° from the filter normal 95% over angles from 30-60° from the filter normal
Polarization	Non-polarizing to within 1% at normal incidence
Absorption	Absorbs less than 10% of incident solar power
Scatter	BRDF at 3° from normal < 0.014 sr ⁻¹ at 1064 nm
Operating Temp	-10°C to +60°C
Shape/Size	2.2-meters circular aperture
Thickness	< 50 microns total (membrane + coatings)
Uniformity	All specifications must be met when averaged over entire filter area
Wavefront	$\lambda/2$ at 1550-nm

Measured and Predicted Transmission



Measured Reflectance on Glass



Coating Design

- All dielectric and semi-conductor design
- 2-sided design, 10-layers on front and 1-layer on back of membrane
- Design tolerance; +/-3% over 1.5-meter coating area
- Future designs, more layers requiring tighter tolerances.

Issues related to coated membranes

- Adhesion of coatings to membrane
- Coating stress
- Mounting and tensioning of membrane
- CTE match between mounting frame, membrane and coating
- Choice of coating materials
 - Cracking
 - Stress

Other applications for solar covers:

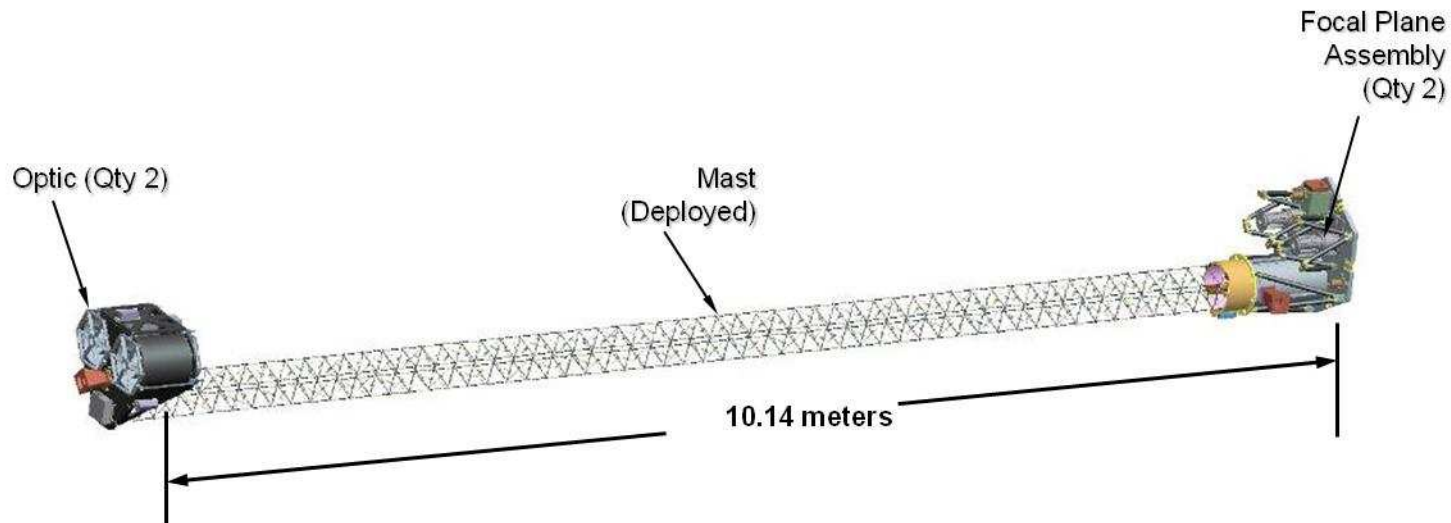
NuSTAR X-Ray Telescope

- Coated membrane mounted on frame
 - Low α/ε (front surface facing sun)
 - 94% or better 6-keV x-ray transmission
 - Low ε on inside surface

NuSTAR Project Description

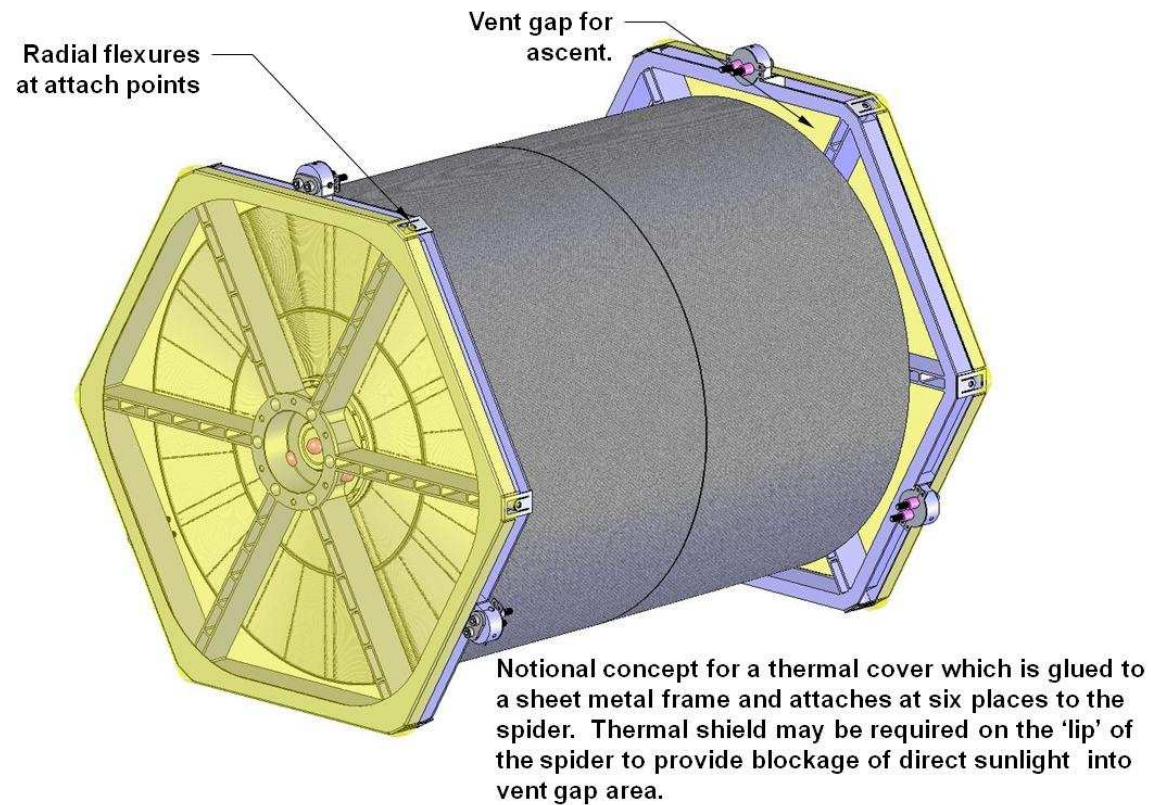
Mission Description

- NuSTAR is a NASA Small Explorer, currently in Phase B with Project PDR in June 2009.
- Two hard x-ray telescopes (6-79 keV bandpass) focus hard X-rays on detectors at a 10m focal distance.



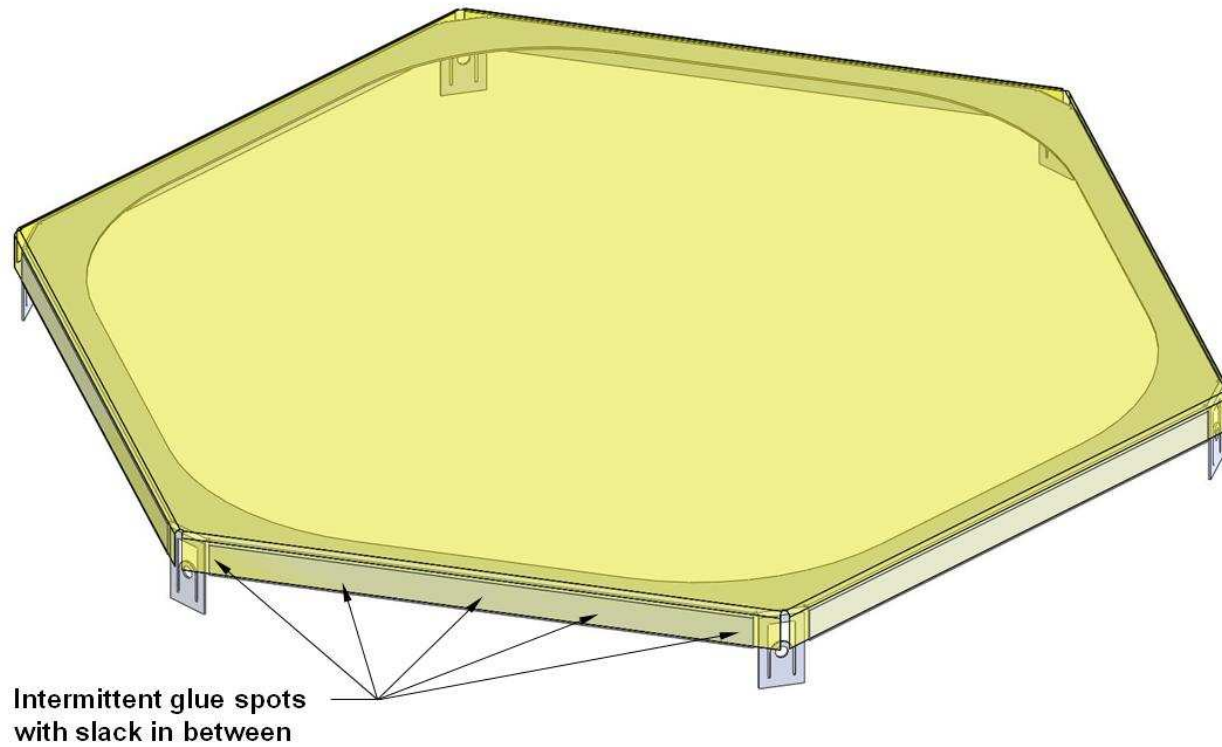
Telescope with cover

A thermal cover is required to control temperature and thermal gradients in the optics, which may point directly at the sun.



Solar rejection filter

The mass of two covers is 0.2 kg

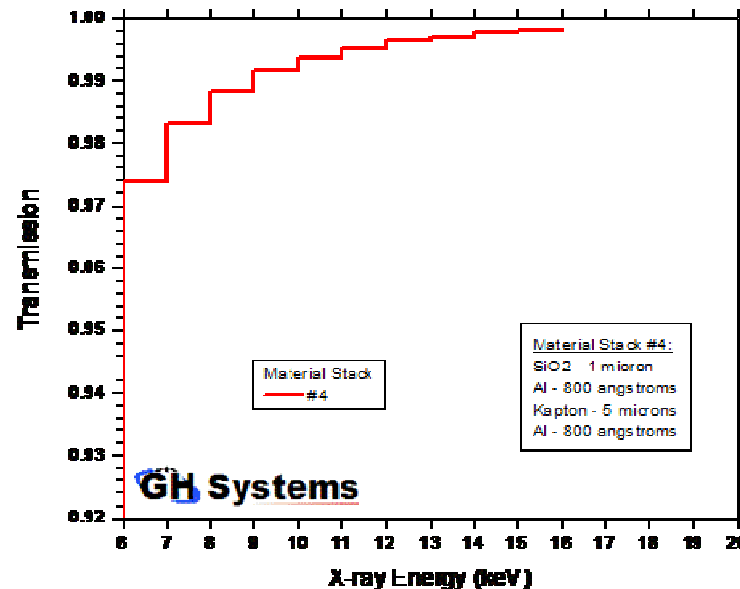


GH Systems X-ray analysis

Throughput

- **L4 Requirement is 90% transmission, at 6 keV, through two covers (entrance and exit). Target is 95% transmission at 6keV for window material and any supporting structure/grid.**

This design would meet requirements, but need to understand how much support structure is required to meet handling, venting requirements.



Conclusions

- Membrane filters for telescopes have been devised for both terrestrial and space-based applications.
- Durable coated membranes have been demonstrated at reasonable cost.
- The Phase II effort will be on improving membrane performance by tightening process control and producing more complex coating designs over large areas.